RAPID BIOASSESSMENT OF THE BARR CREEK AND BIG CREEK WATERSHEDS USING BENTHIC MACROINVERTEBRATES

for the Soil and Water Conservation Districts of Vanderburgh and Posey Counties

Study Conducted in July and December 1994

Study Conducted By:

Commonwealth Biomonitoring 7256 Company Drive Indianapolis, Indiana 46237 (317)887-5855

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EXECUTIVE SUMMARY

A rapid bioassessment technique was used to determine the degree of biological impairment present in Barr Creek and Big Creek in southwestern Indiana prior to full implementation of various land treatments in the Barr Creek watershed. The benthic communities of four sites and a nearby reference stream were sampled during July and December 1994 to provide information on "before treatment" conditions.

The aquatic habitat value of both Barr Creek and Big Creek were quite low compared to that of the reference stream (Rush Creek in western Posey County, which is known to be among the highest-quality headwater streams in southwestern Indiana). Both Barr Creek and Big Creek were highly channelized, with steep bank slopes and stream bottoms composed mostly of sand and silt. Neither stream had much natural riparian vegetation, and shading was nearly absent.

The benthic communities of all study sites were "slightly" to "moderately" impacted compared to that of Rush Creek. Barr Creek appeared to be in better condition than Big Creek, and its benthic community is about as good as present habitat conditions allow. However, Barr Creek also exhibits signs of higher than normal nutrient enrichment, probably from agricultural sources. Big Creek has slightly degraded water quality as well as degraded habitat. There is some evidence that high water temperatures associated with lack of shading may contribute to the biological impairment observed in Big Creek and possibly in lower Barr Creek as well.

Recommendations to restore and enhance the biological condition of these streams include additional land treatments, protecting and planting streamside vegetation, and minimization of ditching projects.

INTRODUCTION

This study was conducted to measure the "biological integrity" of Big Creek and one of its tributaries (Barr Creek) in southwestern Indiana. Both streams have been identified by the Soil and Water Conservation Districts of Vanderburgh and Posey Counties and the Indiana Department of Environmental Management as having seriously degraded water quality due to nonpoint sources of pollution [1]. Soil conservation measures were planned by the Indiana Department of Natural Resources (IDNR) and the Districts to improve the water quality of these streams. By conducting studies of the biological community of Barr Creek and Big Creek before and after application of land treatments in the watersheds, IDNR wanted to determine whether treatments resulted in improved water quality as reflected by an improved aquatic biological community.

Land treatments in the watershed were initiated in October 1993 and continued through the summer of 1994. The first biological study was conducted in July 1994. A second study was planned for October 1994. However, an unusually dry summer caused both study streams to stop flowing for several weeks. Since the bioassessment technique requires flowing waters, the second study was postponed until December 1994, allowing the benthic community a chance to become established once again.

Local Setting

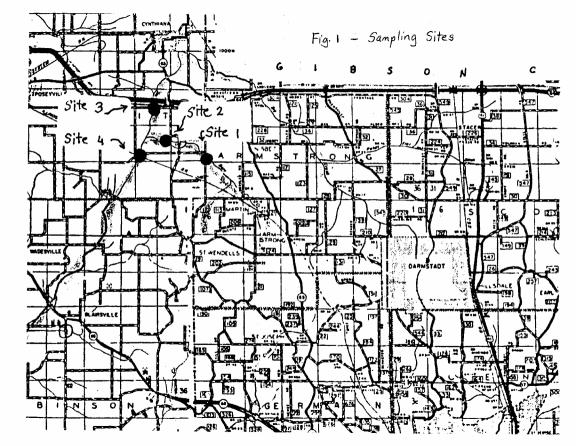
Barr Creek and Big Creek are located in the "Interior River Lowland" ecoregion of the Central U.S. [2]. This ecoregion is composed of a glacial till plain, often covered with a thick layer of loess soils. Land use patterns are extremely variable in this ecoregion because the soils and topography are more variable than in most other ecoregions. Natural vegetation is usually dominated by oak/hickory forests.

Barr Creek is a "third order" stream with a total watershed area of about 36 square kilometers. It originates in Vanderburgh County and flows northwestward, joining Big Creek in Posey County. The lower segments of the stream are channelized but some of the upper tributaries retain their natural channel characteristics and about 25% of the upper watershed is wooded.

Big Creek is a somewhat larger "fourth order" stream and at its juncture with Barr Creek has a watershed area of about 160 square kilometers. Most of its length has been artificially channelized to facilitate drainage of agricultural fields. Less than 10% of the watershed is wooded. There are numerous small oil wells in the watershed.

Four sites were chosen for study in these watersheds (Fig. 1). The sites on Barr Creek were chosen to represent the upper and lower watershed areas. The sites on Big Creek were chosen to represent the watershed upstream and downstream from Barr Creek. A summary of each site and its watershed area is shown below:

| Site 2 | Barr Creek @ County Line Rd. | 23 km^2 |
|--------|--|--------------------|
| Site 3 | Barr Creek @ its confluence w/ Big Cr. | 36 km^2 |
| Site 4 | Big Creek @ Water Tank Rd. | 160 km² |
| Site 5 | Big Creek @ Emge Rd. | 196 km^2 |



METHODS

Because they are considered to be more sensitive to local conditions and respond relatively rapidly to change [3], benthic (bottom-dwelling) organisms were used to document the biological condition of both Barr Creek and Big Creek. The U.S. Environmental Protection Agency (EPA) has recently developed а bioassessment protocol [4] which has been shown to produce highly reproducible results that accurately reflect changes in water We used EPA's Protocol III to conduct this study. quality. Protocol III requires a standardized collection technique. a standardized subsampling technique, and identification of at least 100 animals from each site to the genus or species level from both "study sites" and a "reference site."

Reference Site

A reference site is required for comparison of its aquatic community to that of each study site. The reference site should be in the same "ecoregion" as the study sites and be approximately the same size. It should be as pristine as possible, representing the best conditions possible for that area. Because of extensive drainage projects in southwestern Indiana, most streams in the area have been drastically altered [5]. However, Rush Creek (a third order tributary of the Wabash River in western Posey County) appears to be relatively unimpacted. Much of the Rush Creek watershed is wooded and the stream remains mostly unchannelized. Its watershed area is about 45 square kilometers, which is similar to that of Barr Creek and Big Creek. Agriculture is an important land use in the watershed, but sedimentation does not appear to be as extensive as in Barr Creek or Big Creek. A fisheries study done in 1985 showed that, in contrast to other small streams in the area, Rush Creek still supports a fairly diverse fish community Also, the study showed that Rush Creek is one of the few places in southwestern Indiana which still supports a healthy population of "darters" (fish which are generally sensitive to environmental degradation [7]). The reference site was located on the County Road immediately upstream from Harmonie State Park.

Sample Collection

Samples in this study were collected by kicknet from riffle habitat where current speed was 20-30 cm/sec. Riffles were used because they were the most important benthic habitat present at all study sites. The kicknet was placed immediately downstream from a riffle while the sampler used a hand to dislodge all benthic organisms attached to rocks within the riffle. The organisms were swept by the current into the kicknet and subsequently transferred to a white pan. Each sample was examined in the field to assure that at least 100 organisms were collected at each site. In addition, each site was sampled for organisms in CPOM (coarse particulate organic matter, usually consisting of leaf packs from fast-current areas). All samples were preserved in the field with 70% isopropanol.

Laboratory Analysis

In the laboratory, a 100 organism subsample was prepared from each site by evenly distributing the whole sample in a white, gridded pan. Grids were randomly selected and all organisms within grids were removed until 100 organisms had been selected from the entire sample.

Each animal was identified to the lowest practical taxon (usually genus or species). As each new taxon was identified, a representative specimen was preserved as a "voucher." All voucher specimens will ultimately be deposited in the Purdue University Department of Entomology collection.

Data Analysis

Following identification of the animals in the sample, eight "metrics" were calculated for each site. These metrics are based on knowledge about the sensitivity of each species to changes in environmental conditions and how the benthic communities of unimpacted streams are usually organized. For example, EPT animals consist of those in the insect orders Ephemeroptera, Plecoptera, and Trichoptera, which are known to be more sensitive than most other benthic animals to degradation of environmental conditions. Feeding behaviors such as "scrapers", "filterers", and "shredders" change predictably under different conditions. The sum of all eight metrics provides an individual "biotic score" for each site.

Quality Assurance

To help assure the quality of the results, a duplicate sample was collected at Site 1 during December. The biological scores of each sample were measured to determine the amount of variability associated with the technique. Ideally, the individual scores of duplicate samples should be within about 10% of the mean score to assure that reproducible results are obtained.

RESULTS

Quality Assurance

The biotic index scores of site 1, as determined by duplicate benthic samples, were 40 and 42, respectively, during the December sampling period (see Appendix). These values were within 10% of the mean and the use impairment categories obtained by both samples were identical. This indicates that the bioassessment technique produced reliable results during the study period.

Aquatic Habitat Analysis

When the EPA habitat scoring technique was used, the following aquatic habitat values were obtained for each site in the study:

| | Score | % of Reference |
|--------------------------------|-------|----------------|
| Rush Creek (reference, Site 1) | 107 | 100 |
| Upper Barr Creek (Site 2) | 61 | 57 |
| Lower Barr Creek (Site 3) | 61 | 57 |
| Upstream Big Creek (Site 4) | 59 | 55 |
| Downstream Big Creek (Site 5) | 59 | 55 |

The maximum value obtainable by this scoring technique is 135, with higher values indicating better habitat. Sites with lower habitat values normally have lower biotic index values as well.

The scores indicate that all of the study sites had similar habitat values, all of which were considerably lower than that present at the reference site. All study sites were characterized by extremely steep bank slopes with a paucity of suitable bottom substrate and lack of streamside cover. All study sites also suffered from various degrees of channel alteration, lack of shading, and sediment deposition.

Water Chemistry

The following water quality measurements were obtained at each study site:

Water Quality Measurements
July 1994

| | D.O. mg/l | pH SU | Cond. uS | Temp. |
|--|--------------|----------|-------------|-------|
| | | | | |
| Reference Site 1 9:50 a.m. (7/6/94) | 7.3 | 8.2 | 530 | 78 |
| Site 2 | 15.6 | 8.9 | 390 | 88 |
| 5:15 p.m. (7/5/94) | 10.0 | 0.0 | 250 | |
| Site 3 1:30 p.m. (7/6/94) | 12.2 | 9.3 | 350 | 97 |
| Site 4 | 10.2 | 8.4 | 360 | 91 |
| 2:15 p.m. (7/5/94) | | | | |
| Site 5 | 18.6 | 9.2 | 310 | 95 |
| 3:30 p.m. (7/5/94) | | | | |

Water Quality Measurements December 1994

| | D.O. mg/l | pH SU | Cond. uS | Temp. |
|--|--------------|----------|-------------|-------|
| | | | | |
| Reference Site 1 1:50 p.m. (12/28/94) | 12.0 | 8.0 | 640 | 38 |
| Site 2 | 12.0 | 7.8 | 500 | 40 |
| 5:35 p.m. (12/28/94) Site 3 | 13.0 | 7.9 | 510 | 38 |
| 4:15 p.m. (12/28/94) Site 4 | 13.4 | 8.0 | 440 | 41 |
| 3:20 p.m. (12/28/94) Site 5 | 13.4 | 8.0 | 460 | 42 |
| 5:00 p.m. (12/28/94) | | | | |

D.O. = Dissolved oxygen Cond. = Conductivity Temp. = Temperature in Degrees Fahrenheit

Benthic Communities

The types of benthic organisms collected from each study site are shown in Tables 1 and 3. The metric scores and site scores calculated from these data are shown in Tables 2 and 4.

Table 1
Rapid Bioassessment Results - Barr Creek and Big Creek - July 1994

| | | | Site | # | |
|------------------------------|-----|--------|--------|-----|-----|
| | 1 | 2 | 3 | 4 | 5 |
| Chironomidae | | | | | |
| Glyptotendipes | 1 | | 1 | 32 | 41 |
| Polypedilum convictum | 12 | 1 | | 3 | 2 |
| P. fallax | 2 | 1 | _ | | _ |
| Pseudochironomus | 1 | 1 | 3 1 | | 2 |
| Stictochironomus | 11 | 4 | 3 | 6 | 12 |
| Thienemannymia Simuliidae | 7 | 4 | 3 | ь | 12 |
| Trichoptera | , | | | | |
| Cheumatopsyche | 21 | 54 | 6 | 15 | 2 |
| Hydropsyche simulans | | 0.1 | • | 4 | _ |
| Emphemeroptera | | | | | |
| Caenis | 1 | 6 | 7 | 3 | 1 |
| Stenacron interpunctatum | 24 | 2 | | 3 | 1 |
| Coleoptera | | | | | |
| Enochrus | * | | | 1 | |
| Berosus | 1 | 6 | 13 | 12 | 4 |
| Stenelmis | 1 | 2 | 3 | 17 | 32 |
| Dubiraphia | | | 1 | | |
| Odonata | | _ | | | |
| Ischnura | 1 | 2 1 | 1 | 1 | 1 |
| Argia Amphipoda | 1 | т. | | т. | |
| Hyalella azteca | 1 | | | | |
| Isopoda | | | | | |
| Caecidotea | 13 | | | | |
| Cambaridae | 1 | 1 | | | |
| Gastropoda | | | | | |
| Physella | 1 | 16 | 59 | | 2 |
| Planorbella trivolvis | | 1 | 2 | | |
| Pelecypoda | | | | | |
| Eupara cubensis | 1 | 2 | | 3 | |
| | | | | | |
| Total | 100 | 100 | 100 | 100 | 100 |

Table 2. Data Analysis - July 1994

| | METRICS | | - - - | _ | |
|----------------------|--------------|-----|--------------|-------|------|
| | 1 | 2 | Site 3 | # 4 | 5 |
| # of Genera | 16 | 14 | 12 | 12 | 11 |
| Biotic Index | 6.9 | 7.3 | 8.4 | 7.4 | 7.3 |
| Scrapers/Filterers | 0.9 | 0.3 | 10 | 0.13 | 1.5 |
| EPT/Chironomids | 1.7 | 8.9 | 1.6 | 0.6 | 0.07 |
| % Dominant Taxon | 24 | 54 | 59 | 32 | 41 |
| EPT Index | 3 | 3 | 2 | 4 | 3 |
| Community Loss Index | 0.0 | 0.3 | 0.7 | 0.5 | 0.4 |
| % Shredders (CPOM) | 14 | 0 | 0 | 0 | 0 |
| | SCORING 1 | 2 | Site 3 | # 4 | 5 |
| # of Genera | .6 | 6 | 4 | 4 | 4 |
| Biotic Index | 6 | 6 | 4 | 6 | 6 |
| Scrapers/Filterers | 6 | 4 | 6 | 0 | 0 |
| EPT/Chironomids | 6 | 6 | 6 | 2 | 0 |
| % Dominant Taxon | 4 | 0 | 0 | 2 | 0 |
| EPT Index | 6 | 6 | 4 | 6 | 6 |
| Community Loss Index | 6 | 6 | 4 | 4 | 6 |
| % Shredders (CPOM) | 6 | 0 | 0 | 0 | 0 |
| TOTAL | 46 | 34 | 28 | 24 | 22 |
| % of Reference | 100 | 74 | 61 | 52 | 48 |
| Impairment Category | N | S | S | M | М |
| N = NONE | S = SLIGHT | M : | = MOD | ERATE | |

Table 3
Rapid Bioassessment Results - Barr Creek and Big Creek - Dec. 1994
Site #

| | | | Site | # | |
|----------------------------------|-----|-----|--------|-----|-----|
| | 1 | 2 | 3 | 4 | 5 |
| Chironomidae | | | | | |
| Dicrotendipes neomodestus | | | | | 1 |
| Pseudochironomus sp. | | | | | 1 |
| Orthocladius obumbratus | 18 | 1 | 1 | 1 | 18 |
| Heterotrissocladius sp. | 1 | 2 | 2 | | 3 |
| Parametriocnemus sp. | | 1 | 5 | 2 | 3 |
| Cardiocladius sp. | 1. | | | | |
| Cricotopus bicinctus | | | 1 | | |
| Thienemannymia group | 7 | | 1 | 1 | |
| Simuliidae | 2 | | 1 | 7 | |
| Tipulidae | 1 | | | | |
| Trichoptera | | | | | |
| Cheumatopsyche sp. | 49 | | | 23 | |
| Chimarra obscura | 1 | | | | |
| Neureclipsis sp. | 1 | | | | |
| Emphemeroptera | | | | | |
| Caenis sp. | 1 | | | | 8 |
| Stenacron interpunctatum | 6 | | | 1 | |
| Stenonema tripunctatum | 1 | | | | |
| Plecoptera | | | | | |
| Allocapnia spp. | | 73 | 57 | | 6 |
| Coleoptera | | | | | |
| Berosus sp. | | | | 4 | 6 |
| Stenelmis sp. | • | | 2 | 20 | 18 |
| Dubiraphia sp. | | | | | 1 |
| Odonata | | | | | _ |
| Epitheca sp. | | | | | 1 |
| Argia sp. | | | | 5 | 3 |
| Amphipoda | _ | _ | | | |
| Hyalella azteca | 1 | 1 | | | |
| Isopoda | _ | - 4 | | | |
| Caecidotea sp. | 6 | 14 | 16 | | |
| Lirceus sp. | 2 | 5 | 4 1 | 7 | 8 |
| Turbellaria | 3 | | 1 | , | 0 |
| Gastropoda | | | 5 | 1 | 3 |
| Physella | | | 1 | т. | 3 |
| Planorbella trivolvis | | 1 | _ | 1 | |
| Fossaria sp. | | | | ٠. | |
| Pelecypoda | | 2 | 2 | 20 | 6 |
| Sphaerium sp. Eupara cubensis | 1 | ~ | د. | 3 | • |
| Annelida | | | | 3 | |
| Brachiura sowerbyi | | | | 1 | 6 |
| other Tubificidae | | | 1 | 3 | 8 |
| Other Indilitatione | | | | | |
| | 100 | 100 | 100 | 100 | 100 |
| Total | 100 | 100 | 100 | 100 | 100 |

Table 4. Data Analysis - December 1994 METRICS

| | MEIKI | .C3 | _ | | | |
|----------------------|----------|-----|-----|-------------|----------|------|
| | 9 | 2 | 3 | Site : | # 4 | - |
| | 1 | | | · | 4 | 5 |
| # of Genera | 16 | 9 | 15 | 5 : | 16 | 17 |
| Biotic Index | 7.3 | 4.3 | 4. | .9 | 5.9 | 7.4 |
| Scrapers/Filterers | 0.13 | 0.5 | 2. | 0 0 | .06 | 0.5 |
| EPT/Chironomids | 2.2 | 18 | 5. | 7 6 | .0 | 0.54 |
| % Dominant Taxon | 49 | 73 | 57 | 7 : | 23 | 18 |
| EPT Index | 6 | 1 | 1 | L | 2 | 2 |
| Community Loss Index | 0.0 | 1.1 | 0. | 5 (| 0.4 | 0.5 |
| % Shredders (CPOM) | 69 | 84 | 58 | 3 | 0 | 6 |
| | SCORI | NG | | | | |
| | | 1 | 2 | Site i 3 | ⊭ 4 | 5 |
| | | | | | | |
| # of Genera | | . 6 | 4 | 6 | 6 | 6 |
| Biotic Index | | 6 | 6 | 6 | 6 | 6 |
| Scrapers/Filterers | | 6 | 6 | 6 | 4 | 6 |
| EPT/Chironomids | | 6 | 6 | 6 | 6 | 2 |
| % Dominant Taxon | | 0 | 0 | 0 | 4 | 6 |
| EPT Index | | 6 | 0 | 0 | 0 | 0 |
| Community Loss Index | | 6 | 4 | 4 | 6 | 4 |
| % Shredders (CPOM) | | 6 | 6 | 6 | 0 | 0 |
| TOTAL | | 42 | 32 | 34 | 32 | 30 |
| % of Reference | | 100 | 76 | 81 | 76 | 71 |
| Impairment Category | | N | s | s | s | s |
| N = NONE | S = SLIG | нт | M = | MODE | RATE | |

DISCUSSION

Chemical measurements taken during the study show that dissolved oxygen (D.O.) fell within the range acceptable to most aquatic organisms. Several pH values during July were above 9.0, which is considered the upper limit of acceptability by some animals. Such high pH values were also accompanied by D.O. values well above saturation. These types of conditions are typically caused by rapid algal growth in the waterbody. It is common to find much lower D.O. values at these sites after several hours of darkness, when algal photosynthesis stops and respiration begins.

A total of 22 macroinvertebrate genera were collected at the five sites during July, while 33 genera were present during December. The most commonly collected organisms at most study sites during July were the midge <u>Glyptotendipes</u>, the caddisfly <u>Cheumatopsyche</u>, the snail <u>Physella</u>, or the riffle beetle <u>Stenelmis</u>. Some of these animals were also common during December (e.g. <u>Cheumatopsyche</u>), but other types of animals (e.g. the stonefly <u>Allocapnia</u> and the midge <u>Orthocladius</u>) became dominant at one or more sites during this early winter sampling period.

Figure 2 shows the normal relationship of biotic index scores to habitat values (a linear relationship according to [4]). The figure also shows a range of plus or minus 10% to account for a certain amount of measurement variability. When biotic index values fall below this range, the site typically has degraded water quality. Only the two sites on Big Creek during the July sampling period fell below the expected range. Extremely high water temperatures during July (up to 97° F) probably contributed to his problem.

Figure 2 also indicates that none of the study sites had biotic values lower than expected from their measured habitat values during December. In fact, most sites had biotic index scores which were somewhat higher than predicted by their available habitat. This situation is often found at sites affected by nutrient enrichment. Under such conditions, high nutrient inputs sustain the benthic fauna at a higher-than-expected level. However, as habitat or water quality degradation proceeds, nutrients are no longer able to sustain the community at the same level, and a drastic decrease in biological condition results [4]. Therefore, without some type of watershed management to keep conditions from deteriorating further, both Barr Creek and Big Creek may be poised on the brink of a steep decline in biological condition.

There is a strong indication that most sites, including the reference stream, were at least periodically exposed to high Tables 5 and 6 show the turbidity and/or sedimentation. relationship of the animals present at each site to their tolerance to high turbidity and sedimentation. The tables show that a large proportion of benthic animals in these streams were "tolerant" to Few "intolerant" animals were present. exception to this observation was the large number of stoneflies (<u>Allocapnia</u> sp.) present in Barr Creek samples during December. This species, which is thought to be intolerant to sediment deposition, is known as a "winter stonefly" because it lies dormant in the egg stage deep within the stream bottom during the warmer months and emerges as an adult during late winter. The presence of numerous winter stonefly nymphs is a good indication that, despite a high degree of agricultural activity in the watershed, sediment deposition is probably not exceptionally high in Barr Creek.

Finally, there is also strong evidence that the reference stream itself (Rush Creek, as it flows into Harmonie State Park) may be somewhat degraded by less than desirable water quality from "organic" inputs (e.g. animal wastes or septic tank effluents). The Hilsenhoff Biotic Index ("Biotic Index" in Tables 2 and 4) is very sensitive to this type of stress. During both July and December, the Hilsenhoff Index value was between 6.9 and 7.3, which is considerably higher than found in most unpolluted Indiana streams and, according to [15], is indicative of "fairly poor water quality from significant organic pollution."

Figure 2

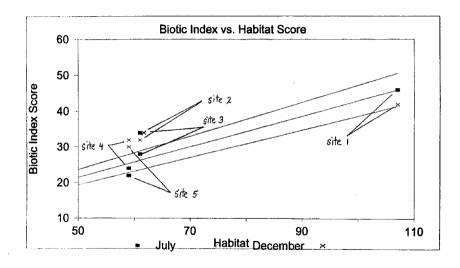


Table 5. Sediment-Tolerant Species Observed (References shown in brackets)

| Cheumatopsyche sp. | [8] | [9] |
|--|-------------|-------|
| Caenis sp. Stenacron interpunctatum | [9] [9] | [11] |
| Polypedilum convictum Thienemannymia group | [9] [9] | |
| Argia spp. Ischnura spp. | [9] [9] | |
| Macronychus glabratus Berosus sp. | [9] [12] | |
| Tubificidae | [11] | |
| SEDIMENT-TOLERANT ORG | SANISM | is |
| % of All Organisms at the Reference % of All Organisms at the Study Sit Site 2 74% Site 3 32% Site 4 43% Site 5 23% | | · 71% |
| December Samples % of All Organisms at the Reference % of All Organisms at the Study Sit Site 2 38% Site 3 40% Site 4 53% Site 5 39% | | e 63% |

Table 6. Sediment-Intolerant Species Observed (References shown in brackets)

| Plecoptera | [9] |
|---|---|
| Stenonema tripunctatum | [9] |
| Chimarra sp. | [9] |
| Hyalella azteca | [10] |
| July Samples | NT-INTOLERANT ORGANISMS |
| % of All Organisms a % of All Organisms a Site 2 0% Site 3 0% Site 4 0% Site 5 0% | at the Reference Site 1% at the Study Sites |
| December Samples | |
| % of All Organisms a % of All Organisms a Site 2 74% Site 3 57% Site 4 0% Site 5 6% | at the Reference Site 3% at the Study Sites |

Mussel Observations

Although not part of the original study plan, observations of mussels present in a stream are often useful. Mussels are very sensitive to changes in stream conditions and can be used to judge stream quality [16]. The following mussel species were observed at Site 3 on Big Creek:

Live Specimens

Lasmigona complanata (White heelsplitter)
Anodonta grandis (Giant floater)
Valves Only (2 valves, still attached)
Elliptio dlatata (Spike)
Leptodea fragilis (Fragile paper shell)
Toxolasma texasensis (Texas lilliput)

Most of these species are widespread and fairly common in the Midwest. The Texas lilliput is a southern species, and extreme southwestern Indiana is at the northern part of its range.

Comparison to Other Studies

A fisheries study done in 1985 [6] showed that the fish community of Barr Creek was not very diverse (a total of 9 species at two sites) and was dominated by tolerant "minnow" species. In addition, the fish community of Big Creek [5] found that in the summer of 1980 Big Creek and its tributaries had relatively depressed fish communities, associated with low habitat value and high turbidity and sedimentation. The scientists conducting this study reported that Big Creek was dominated by a few "tolerant" species (those able to survive in conditions of poor water quality and degraded habitat) and that "intolerant" fish were virtually absent from most locations in the watershed. Only 10 fish species were present at two collecting sites on the upper portion of Big Creek. Healthy stream sites typically support 15-20 species. These two fisheries reports support the present study, showing that neither Barr Creek nor Big Creek are very good aquatic resources in their present states.

In contrast to these recent studies, older studies show that environmental conditions in Big Creek were once much better. For example, Gerking [13] collected 28 fish species, including the tadpole and brindled madtoms, at his two collecting sites on Big Creek in 1942. These relatively intolerant species have disappeared from the stream in the past 50 years. An even older study by Jordan [14] reported the presence of additional intolerant fish in his Big Creek collections of 1888. These included the bluntnose, johnny, slenderhead, and blackside darters, as well as the pugnose minnow. None of these species has been collected from Big Creek during the past 100 years. Habitat alterations and degraded water quality have probably eliminated these fish.

RECOMMENDATIONS

- Continue to monitor these five sites during 1995 to determine whether land treatments in the Barr Creek watershed contribute to improved water quality.
- In addition to encouraging erosion control practices, consider implementing programs which protect or restore natural streamside vegetation.
- 3. Identify all areas in both watersheds with severely slumping banks and implement stabilization projects (methods using natural vegetation should be preferred to riprap, since lack of shading is a problem in these watersheds).
- 4. Severe channelization of local streams has contributed to some of the observed water quality problems. Encourage local drainage boards to minuimize the frequency and magnitude of "ditching" projects in this area.
- 5. Although it is presently one of the highest-quality headwater streams in this area, Rush Creek appears to be in need of better watershed management practices as well. There seem to be unusually high sediment and "organic" inputs to this stream, possibly from livestock operations or failing septic tanks. Determine whether local landowners would be willing to participate in cost-share programs aimed at reducing these inputs.

LITERATURE CITED

- 1. Indiana Department of Environmental Management. 1989. Nonpoint Source Water Pollution Assessment Report. Office of Water Management, Indianapolis, IN.
- 2. Omernik, J.M. and A.L. Gallant. 1988. Ecogregions of the Upper Midwest States. U.S. EPA Environmental Research Laboratory, Corvallis, OR. EPA/600/3-88/037.
- 3. Hynes, H.B.N. 1970. The ecology of running waters. Univ. of Toronto Press, Toronto. 555 pp.
- 4. Plafkin. J.L., M.T. Barbour, K.D. Porter, S.K. Gross, and R.M. Hughes. 1989. Rapid bioassessment protocols for use in streams and rivers. U.S. EPA Office of Water, Washington, D.C. EPA/444/4-89-001.
- 5. Kozel, T.R., G.K. Weddle, K.L. Welborn, J.T. Dailey, D.C. Dailey, and M.W. Denner. 1981. A fish faunal survey of Posey County, Indiana. Proc. Ind. Acad. Sci. 90:446-453.
- 6. Grannan, L.T. and J.C. Lodato. 1986. Status and distribution of darters in Southwestern Indiana. Report to the Indiana Department of Natural Resources. 22 pp.
- 7. Karr, J.R. et al. 1986. Assessing biological integrity in running waters: a method and its rationale. Illinois Natural History Survey, Special Publication 5. 28 pp.
- 8. Lenat, D.R. 1984. Agriculture and stream water quality: a biological evaluation of erosion control practices. Environ. Manag. 8:333-344.
- 9. Roback, S.S. 1974. Insects (Arthropoda:Insecta). In Hart, C.W. and S.L.H. Fuller, eds., Pollution ecology of freshwater invertebrates. Academic Press, New York, 389 pp.

- 10. Pennak, R.W. 1989. Freshwater invertebrates of the United States. John Wiley & Sons, New York, 628 pp.
- 11. Whiting, E.R. and H.F. Clifford. 1983. Invertebrates and urban runoff in a small northern stream, Edmonton, Alberta, Canada. Hydrobiologia 102:73-80.
- 12. Gammon, J.R. 1970. The effect of inorganic sediment on stream biota. U.S. EPA Water Quality Office, Washington, D.C. 141 pp.
- 13. Gerking, S.D. 1945. Distribution of the fishes of Indiana. Invest. Ind. Lakes & Streams. Vol III. Ind. Dept of Conservation and Indiana University.
- 14. Jordan, D.S. 1890. Report of explorations made during the summer and autumn of 1888 in the Allegheny region of Virginia, North Carolina, and Tennessee, and in wester Indiana, with an account of the fishes found in each of the river basins of those regions. Bull. U.S. Fish Comm. 1888, 8:97-173.
- 15. Hilsenhoff, W.L. 1987. An improved biotic index of organic stream pollution. Great Lakes Entomologist. 20:31-39.
- 16. Cummings, K.S. and C.A. Mayer. 1992. Field guide to freshwater mussels of the Midwest. Illinois Natural History Survey, Manual 5. 194 pp.

Rush Creek Duplicates Metric Values

| | Sample 1 | Sample 2 |
|-------------------------|----------|----------|
| Total Genera | 16 | 16 |
| EPT Genera | 5 | 6 |
| Scrapers/Filterers | 0.15 | 0.13 |
| % Dowinant Taxon | 41 | 49 |
| EPT/Chironomids | 1.6 | 2.2 |
| Community Loss Index | 0.0 | 0.0 |
| Hilsenhoff Biotic Index | 7.3 | 7.3 |
| % Shredders in CPOM | 37 | 69 |

Site Scores in Relation to the Reference

| | Sample 1 Sample 2 as Reference | Sample 2 Sample 1 as Reference |
|----------------------|-----------------------------------|-----------------------------------|
| Total Genera | 6 | 6 |
| EPT Genera | 4 | 6 |
| Scrapers/Filterers | 6 | 6 |
| % Dominant Taxon | Ð | Ð |
| EPT/Chironomids | 6 . | 6 |
| Community Loss Index | : 6 | 6 |
| Hilsenhoff Biotic In | dex 6 | 6 |
| % Shredders in CPOM | 6 | 6 |
| | poses target factors | man sorte artis. |
| | 40 | 42 |

Mean Site Score = 41

Each duplicate is within 10% of the mean

Each score indicates "nonimpaired" conditions

| Type of Sampler Kicker Collection Depth Substrate Type Riffle Remarks Sorled by M. Bra Identification by | MACRO Let addus Broadd Broadd | INVE | RTEBRA | Sample No. # Date 12/28/94 Location Rush Creek (fo. Station # Site Collector G. Bright ame on Blank Line. | sey Co | | |
|--|-------------------------------|----------------|----------|--|------------|----|----|
| Enter Family and/or Gent | rs~ana | Spec | ies Na | ame on Blank Line. U | | | r |
| Organisms Diptera | No. | A. | I. | Coleoptera | No. | Α. | Ι. |
| Chironomidae | | <u> </u> | | oo reopter a | | | |
| Ochacladuis CO. | 17 | ļ | | | | | |
| Parametriocnemus | | ├ ─ | \vdash | | | | |
| Parametriocnemus Cardiocladiús Heterotrissia cladiús | 2 | | | Neuroptera and Megaloptera | | | |
| | | | | Crustacea | | | |
| | | | | Isopoda | 2 | | |
| | | | | | | | |
| | | | | Oligochaeta Tubificidae | 2 X | | |
| Other Simuludae | 24 | | | | | | |
| Tipulidae Trichoptera | | <u> </u> | \vdash | | | | |
| Chaumotoreche San | 41 | - | \vdash | | | | |
| Cheumatopsyche spp Cyrnellus trat | | | | Hirudinea | | | |
| Chimarra obscura | | | | | | | |
| | ! | - | | Bivalvia | | | |
| | | | | Sphaerida e (Eupara) Sphaerium | 3 | | |
| Plecoptera | | | | Sphaerium | 3 | | |
| | | | | | | | |
| | | | | Gastropoda | | | |
| | | | | | | | |
| Ephemeroptera | | | | | | | |
| Stenancon Interpractatum Stenanema tripunctatum | 4 | | | | | | |
| Stenonema tribunitation | | | | Bryozoa | | | |
| | | | | | | | |
| | | | | Coelenterata | | | |
| | | | | 011 | 6.PS | | - |
| <u>Odonata</u> | | | | Other Turbellaria | 613 | | |
| | | | | | | | |
| Hemiptera | | | | | | | |
| | | \vdash | | | | | |
| | | | | | | | |
| A = Adult. I = Immature Total No. Organisms | 100 |) | | Total No. Faxa 16 | | | |

CPOM = 37% shredders

| | MACRO | INVE | RTEBRA | ATE DATA SHEET | | | |
|--|---|--|-------------------|--|---|----|--------------|
| Type of Sampler <u>Kicknet</u> Collection Depth Substrate Type <u>riffle</u> | <u>e+ </u> | | | Sample No. #2 | <u>. </u> | | |
| Collection Depth | | | | Date | | | |
| Substrate Type <u>riffle</u> | | | <u> </u> | Location | | | |
| Remarks Sorted by M | Brigh | Ł | | Rush Creek (Posey | (0.) | | |
| . Sorted by M. | Brada | | | | | | |
| | 6. Brigi | 4+ | | Station # <u>SHe I</u> | | | |
| Identification by Man | madel | KLS. | | Collector G. Bright | | | |
| Enter Family and/or Genu | is and | Spec | ies Na | Station # <u>SHe I</u> Collector <u>G. Bright</u> ame on Blank Line. | | | |
| Organisms | No. | A. | I. | | No. | Α. | I. |
| Diptera | | <u> </u> | | Coleoptera | | | <u> </u> |
| Chironomidae | | | oxdot | | | | <u> </u> |
| Orthocladius obumbratus | 18 | | | | | L | L |
| Cardiocladius 4. | 1 | 1 | | | | | |
| Cardiocladius sa. Heterotrissocladius sa. Thienemannymia grolip | 1 | 1 | | | | | - |
| The proming will and | 7 | T | | Neuroptera and Megaloptera | | | |
| provide survival and the | | | | | | | |
| | | | \vdash | Crustacea | | | |
| | | | -1 | Carcilates Ch. | 6 | | |
| | | | 1 | Caecidotea sp. Hyalella azteka | 1 | | |
| | | | \vdash | Hyairija azitec | | | |
| | | | | | | | |
| ON STATE OF | | <u> </u> | | <u>Oligochaeta</u> | | | |
| Other Tipula sp. | | | | | | | |
| Simuludae | | | \vdash | | | | |
| Trichoptera | | | | | | | |
| Chimarra obscura | | | | | | | |
| Cheumatopyche spp. Neuroclipsis sp. | 49 | <u> </u> | | Hirudinea | | | |
| Neurecliesis so. | | | \longrightarrow | | | | <u> </u> |
| , , | | $ldsymbol{\sqcup}$ | | | | | <u> </u> |
| | | | | Bivalvia | | | |
| | | | | Eupera cubensis | | | |
| Plecoptera | | | | | | | |
| | | | | - | | | |
| | | | | | | | |
| | | | | Gastropoda | | | |
| | | | | | | | |
| Ephemeroptera | | | | | | | |
| Conic | | | | | | | |
| Caenis sp. Stenonema tripunctatum | | | | | | | |
| STENONEMU Tribunctatum | (0 | - | | Bryozoa | | | |
| Stenacron interprinctatum | | | $\overline{}$ | DI YOZOG | | | |
| | | | | | | | |
| | | | | Caalaatauata | | | |
| | | | | Coelenterata | | | |
| | | | | 77 1 11 | 3 | | |
| <u>Odonata</u> | | | | Other Turbellaria | | | |
| | | | | | | | - |
| | | | | | | | |
| | | | | | | | |
| Hemiptera | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | L | | |
| A = Adult. I = Immature Total No. Organisms | |) | | Total No. Taxa | | | |

CPOM = 69% shedders

PHYSICAL CHARACTERISATION/WATER QUALITY

| DEPOSITE COMMANCEMENTATION DISTANCE COMMANCE CONTROL OF PARTIES PERSON PRODUCTS AND THE CONTROL OF PARTIES Lecal Watershad Streets One (Martin) Lecal Watershad Streets Office (Martin) Lecal Watershad Streets Width 2 martinated Streets Depth Military Lecal Watershad Streets Width 2 martinated Streets Depth Military Lecal Watershad Streets Width 2 martinated Streets Depth Military Lecal Watershad Streets Width 2 martinated Streets Depth Military Lecal Watershad Streets Width 2 martinated Streets Depth Military Lecal Watershad Streets Width 2 martinated Streets Lecal Watershad Streets Width 2 martinated Streets Lecal Watershad Streets Depth Military Lecal Watershad Streets Depth Military Lecal Watershad Streets Lecal Watersh | FIELD DATA SHEET | Rush Creek |
|--|--|-----------------------|
| Procedurant Surrounding Land West Percent FleidyPhothus (approxituters) Residential Commercial Sendential Commercial Sedential Other Level Watershed Steeles Bose (Endatris) Residential Steeles Steeles Steeles Steeles Steeles (Endatris) Residential Steeles Steeles Steeles Steeles (Endatris) Residential Steeles Res | PRISICAL CRANACTERISATION | |
| Process for Principalities (agricultural) Residential Communical Feduratial Other Level Miderature (agricultural) Residential Communication Foot (agricultural) Residential Communication Foot (agricultural) Residential Survey Level Miderature Style Political por orientee (agricultural) Survey Obrieve Sevices Retitanted Street Width 3 - Retitanted Street Republic Street Retitanted Street Width 3 - Retitanted Street Republic Street Retitanted Street Width 3 - Retitanted Street Republic Street Retitanted Street Rets | | |
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| Lecal Watershed Bresion: Boss Reduction Beary Lecal Watershed Stress Width 2 | | |
| Laces Watershed 275 Felintians | ferent field/fasture Agricultural Residential Commercial Industrial | Other |
| Rich Mater Rock | Local Watershed Brasies: Home (Hoderate) Heavy | |
| Some Westvers Secret Secre | | |
| Second Companies (Second Second Secon | Zatimated Steam Midth 🔏 m Satimated Stroom Dapth: Alfflo O.1 p Sum p pe | ··· <u> </u> |
| Second Companies (Second Second Secon | digh Mater Mark A Valecity Dos Present: Pos Ms V Chemaslised: | 100 / I Some unstream |
| Assertant Control (Assert Assert Assertant Consider) Assertant Control (Assert Assert Assertant Consider) Assertant Control (Assert Assertant Consider) Assertant Control (Assert Assertant Consider) Assertant Control (Assert Assertant Consider) Assertant Control (Assertant Consider) Assertant Consider Consider (Assertant Consider) Assertant Consider (As | Conspy Covery Open Partly Open Partly Shaded Shaded | |
| Several District Type District Companies Compa | | |
| Sediment Oijes (mann) Sieght Roductus Professe Fediment Deposition Siddes Sardent Paper Piber Isad Selici Shells Siber Are the undersides of stems which are not despit enteded block? Yes Specially Sediment Sed | | |
| Professional Deposition Study Services Paper Fiber Field Bellet Shorts Sther From Revenue Published States and Applicate States and App | | |
| Targenic sphatesis Companies Targenic sphatesis Companies Description Descriptio | | |
| TRATEGRAL STANDARD COMPARISON PARTITION TYPE Disenter is despitated to substitute type Substitute type Comparition to substitute type Substitute type Characteristic is length to substitute type Characteristic is length to substitute type Characteristic is length to substitute type Characteristic type Conductivity Characteristic type Conductivity Other Conductivity Other | | ither |
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| Defects 1354-00 [15 la.] 15 colded 15 col | Composition | Composition |
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| Break Break | Boulder 3354-on (16 la.) | ree fiset |
| HATTE CONSTITUTE MATTER CONSTIT | tobblo 64-156-mm (2.5-10 to.) 20 Muchamud 910- | etals (CPON) |
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| Temperature C Discolved Organs pH Conductivity Other Leatermontal Head Market Discolves Wesserter Market Discolves Surveys Patrologue Chamical Esse Other Market Surface Office Signify Temple temple Opens Water Color MEMORY Surface Office Signify Temple temple Opens Water Color MEMORY COUNTRIES CONSTITUTORS PHOTOGORAPH MUMBER | | poste |
| Temperature C Discolved Organs pH Conductivity Other Leatermontal Head Market Discolves Wesserter Market Discolves Surveys Patrologue Chamical Esse Other Market Surface Office Signify Temple temple Opens Water Color MEMORY Surface Office Signify Temple temple Opens Water Color MEMORY COUNTRIES CONSTITUTORS PHOTOGORAPH MUMBER | | |
| Temperature C Discolved Onygon pH Conductivity Other Leatermontal Seed Market Discolver (Marketty) Market Discolver (Marketty) Market Discolver (Marketty) Market Discolver (Marketty) Market Surface Office discolver (Chamical Ease Other Market Surface Office (Marketty) Market Conductions Market Con | | |
| Mater defect (Standard Contester) Water defect (Standard Contest Cont | | *** |
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| AND | | |
| | | |

| | | | Category | | |
|-----|--|---|--|---|--|
| 4.6 | tat Parameter | Excellent | Good | Fair | Poor |
| ١. | *Bottom substrate(| Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable habitat. (16-)20 | 30-50% rubble, gravel or other stable habitat. Adequate habitat. | 10-301 rubble, gravel or other stable habitat. Habitat availability less than desirable. 6-10 | Less than 10% rubble gravel or other stable habitat. Lack of habitat is obvious. |
| 2. | Embeddedness (b) | Gravel, cobble, and boulder particles are between 0 and 25 % surrounded by fine sediment | Gravel, tobble, and boulder perticles ere between 25 and 50 t sucrounded by fine sediment | Gravel, cobble, and boulder particles are between 50 and 75 & sucrounded by fine mediment | Gravel, cobbie, and boulder particles are over 75 % surrounded by fine sediment |
| | | | | | |
| 3. | f0.15 cms (5cfs) + *flow at rep. low flow | Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20 | 0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15 | 0.01-0.01 cms (.5-1 cfs) 0.03-0.05 cms (t-2 cfs) 6-10 | |
| | or D.15 cms Scf> + Velocity/depth | slow ((0.3 m/s), deep (>0.5 m); slow, shallow ((0.5 m); fest (>0.3 m/s), deep; fast, shallow habitats all | only 3 of the 4 hebitst categories present (minsing riffles or twos receive lover score than missing pools). | only 2 of the 4 habitet categories present (missing tiffles/tune receive lower score). | Dominated by one velocity/depth category fuscally peals. |
| | | present. (16)20 | .11-15 | 6-10 | 0-5 |
| 4. | * Channel alteration ^[4] | Little or no enlarge- ment of islands or point bars, and/or no channelization. | Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. | Hoderate deposition of new gravel, coarse send on old and new bars; pools partially filled w/sill; and/or ambank- ments on both banks. | Heavy deposits of fine material, increased bar development; most pools filled w/milt; and/or estensive channelization 0-1 |
| 5. | Bottom scouting and deposition | Less than 5% of the bottom affected by scouring and deposition. | 5-101 affected. Scour at constrictions and where grades steepen. Some deposition in pools. | 10-50t affected. Deposits and scour at obstructions, constructions and bends. Some filling of pools. | More than 50% of the bottom changing nearly year long. Pools almost absent due to deposition. Only large cocks |
| | | 12-15 | •(1) | 4-7 | in ciffle exposed. |

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

Site 1

| Sabitat Parameter | Excellent | Good | FALL | Poor |
|---|--|--|--|--|
| Pool/[iffle, tun/bend ratio distance between riffles divided by stream width) | 5-7. Variety of habitat. Deep riffles and pools. | 7-15. Adequate depth in pools and citfles. Bends provide habitat. | 15-25. Occassional riffle or bend. Sottom contours provide some habitat. | >25. Essentially a straight stream. Generally all flat water or shallow riffle. Poor habitat. |
|). Bank stability ^(a) | Stable. He evidence of ecosion or bank failure. Side slopes gener- ally (304. Little potential for future problem. | Hoderately stable. Infrequent, small areas of erosion mostly healed over. Side slopes up to 40 to on one bank. Slight potential in extreme floods. | Hoderately unstable. Hoderate frequency and size of erosional areas. Side slopes up to 60% on some banks. High erosion potential during extrame high flow. | "Raw" Breas frequent along Straight sections and bands. |
| | 9-10 Over 80% of the | 50-791 of the streambank | 3-5 | 0-3 |
| I. Bank vegetglive stability | streambent surfaces covered by vegetation or bouldega and cobble: 9-10 | 50-79% of the streambank surfaces covered by vegetation, gravel or larger meterial. 6-8 | 25-49t of the stream- bank surfaces covered by vegetation, gravel, or larger material. 1-5 | Less then 25% of the streambank surfaces covered by vegetation. gravel, or larger material. 0-2 |
|). Streamside cover ^(b) | Dominant vegetation is shoub, | Dominant vegetation is of tree form. | Dominant vegetation is grass or forbas. | Over 50% of the stream- bank has no vegetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. |
| Column Totals | | | · · · · · · · · · · · · · · · · · · · | |
| | Score 107 | 38 | | |

Figure 5.2-1. (Cont.).

| | | Liero | DATA SHEET | Barr (| Creek - DK | |
|--|--|---------------------------------------|-------------------|---|---|-----|
| PREDICAL CHARACT | ERISATION | | | | | |
| SIPARIAN SORE/IN | STEEN PERTURES | | | | | |
| Predeminant Sugr | syndlag Lond Veet | | | | | |
| 701061 (PIA) | d/Pasture \ Agriculture | Besidential | Consectat 10 | destrict Other | | |
| Local Watershed | Fresion: Bone Hoderate | # # # # # # # # # # # # # # # # # # # | | | | |
| Local Watershed | ers rettution: Po eriden | co some Petentie | 1 Sources Obvieus | Sources . | | |
| Estimated Streen | width 2 m Setimated | Strace Dopth: Biffl | 0.05. | · · · · · · · · · | | |
| High Water Hath | . Volumetry | Dan Prosent: Too | - So V Cheane | illand: Tou V No _ | - few spots w/ | |
| Canopy Covers 6 | pon Partly Open | Partly Shaded: | theded | | eurren | ŀ |
| BEDINENT/ (PROSTAN | Y81 | | | | | roa |
| Sediment Diores/ | - ^ | etrotoum Chosic | al Amerebic | Sees Other | ~ y p | 30c |
| Sediment Gits: | <u>ح</u> ــــــــــــــــــــــــــــــــــــ | erete Profuse | | | | JUC |
| Sediment Deposit | | Paper Piber | nand Bollet Shell | a diber | | |
| - | so of stomes which are not | | | | | |
| | norganic Substrate Company | ata . | | rgamic Substrate Compan | ente | |
| | | Patcant Compacition | | *************************************** | Percent Compasition | |
| Sobetrate Type | Disaster | in Section Area | Bubstrate Type | Cheresteriatie | 10 Sempling Ares | |
| Bodrock Boulder | >296-00 (10 (0.) | | Detritue | Sticks, Wood, Contac Diept | | |
| | | | ! | Materials (CPOM) | | |
| | 44-236-an (2.5-10 In.) | 1O | Bock-Bud | Black Tore Sine | | |
| Graval Sand | 44-256-an (2.5-10 in.) 1-66-nn (6.1-1.8 in.) - 0.06-2.00-nn (grittp) - | -760 -60 | Ruch-Aud | Binch, Very Fine Organic (PPOM) | | |
| Gravel Seed Silt | 44-136-an (2.5-10 in.) | | Nucl-Hud Naci | Binch, Tory Fine | | |
| Cobble Graval Gr | de-Já-as (1.3-12 la.) folios (1.1-12 la.) folios (1.1-12 la.) de-Já-as (1.1-12 la.) | -60 30 | i | Black, Very Fine Organic (FPOM) Grey, Shell Frequents | | |
| Graval Sand Silt Clay WATES QUALITY Touperature Instrumentia) Pa- Streem Type: Col Water Odoro: No | de-jid-na (1.1-ji la.) j-de-ing (ci.)-ji la.) | pd | Conductivity | Black, Very Fine Organic (FPOM) Grey, Shell Frequents | at mouth, | |
| Graval Sand Sile Clay WATER QUALITY Tomperatura Instrumential De Strano Type: Co Water Oddool De water Strano Strano Tunbidity: Class | de-jid-na (1.1-ji la.) j-de-ing (ci.)-ji la.) | pd | Conductivity | Black, Very Fine Organic (FPOM) Grey, Shell Frequents | at month | 1 |
| Graval Sand Site City WATER QUALITY Tompurature Incommental De- Recess Type: Col Water Odoso: No Water Surface Of Turbidity: Chai | de-jid-an (11-1-1 in.) | ps | Conductivity | Birch, very film dignals (1798) or (1798) Frequents Other | at month, stream botton is hardpan hedrock in so | or |

| | | Category | > | 7/5/99 |
|---|---|---|---|---|
| labitat Perameter | Excellent | Good | Fair | Poor |
| svailable cover | Greater than 50% rubble, gravel, submerged logs, undercut banks, or other stable hebitst. 16-20 | | 10-30% rubble, gravel or other stable habitet. Habitat availability less than desirable. 6-10 | Less than 10% cubble gravel or other stable habitat. Lack of habitat is obvious. |
| 2. Embeddedness ^(b) | Gravel, cobble, and boulder partirles are between 6 and 25 % surrounded by fine sediment 16-20 | Gravel, cobble, and boulder particles are between 25 and 50 % surrounded by fine sediment [1-15] | Gravel, cobble, and boulder particles are between 50 and 75 t surrounded by fine redishent | Gravel, cobble, and beuider particles are over 75 % surrounded by fine sediment |
| 1. 40.15 cms (5cfs) = *Floying trep. low flow | Cold >0.05 cms (2 cfs) Warm >0.15 cms (5 cfs) 10-20 | 0.03-0.05 cms (1-2 cfs) 0.05-0.15 cms (2-5 cfs) 11-15 | 0.01-0.01 cms .5-1 cfs 0.03-0.05 cms (1-2 cfs) 6-10 | |
| or 19,15 cme (5cfs) + Valocity/depth | Slow (c0.3 m/s), deep (>0.5 m); slow, shallow (c0.5 m); fast (>0.3 m/s), deep; fast, shallow habitats all present. | (missing riffles or runs | only 2 of the 4 habitst categories present (missing tiffles/tuns receive lower score). | Bominated by one velocity/depth category (uscally pool). |
| | present. 16-20 | .11-15 | (6-)0 | 0+5 |
| 4. † Channei alteratio | n(a) Little or no enlarge- ment of islands or point bars, end/or- no channelization. | Some new increase in bar formation, mostly from coarse gravel; and/or some channelization present. | Hoderste deposition of new gravel, coarse sand on old and new bers; pools partially filled w/silt; and/or embank- ments on both banks. | Heavy deposits of fine material, increased bar development; most pools filled w/silt; and/or estensive channelization. 0-1 |
| 5. Bottom scouring and deposition | Less than 5% of the bottom affected by scouring and degosition. | 5-10% affected. Scout at constrictions and where grades steepen. Some deposition in pools. | 10-50% affected. Deposits and scour at obstructions, con- strictions and bends. Some filling of pools. | More than 50% of the bottom changing neacly year long. Pools almost absent due to deposition. Only large cocks |
| | 12-15 | 6-11 | | in ciffic exposed. |
| (a) From Ball 1982. | | 1. | 35 | |

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

| | WIDITAT A | SSESSMENT FIELD DATA SHEET I | Rarr | : 2 and 3 Creek |
|---|---|--|---|--|
| | WALLYL Y | SSESSMENT FIRED DATA SHEET I | ملح | 7/5/01 |
| bitat Parameter | Excellent | Good | Fair Polit | 1/3/79 |
| Pool/[[ffie, run/bend ratio (distance between riffles divided by stream width) | 5-7. Variety of habitat. Deep riffles and poels. | 7-15. Adequate depth an pools and taffles. Bends provide habitat. | 15-25. Occassional riffle or bend. Bottom contours provide come habitat. |)25. Essentially a attaight atream. Generally all flat water or shallow riffle. Poor habitat. |
| | 12-15 | 8-11 | <u> </u> | 0-3 |
| . Bank stebility ^(a) | Stable. No evidence of ecosion or bank failure. Side slopes generally (30%), Little potential for future problem. | Moderately stable. Infraquent, small areas of erosion mostly healed over. Side slopes up to 40% on one bank. Slight potential in extreme floods. | Moderately unstable, Noderate frequency and size of srosional areas. Side alogus up to 60% on some banks. Migh erosion potential during extreme high flow. | "Raw" areas frequent along straight sections and bends. |
| | 9-10 | 6-1 | 349 | 0-3 |
| Bonk vedetětive | Over 10t, of the streambank surfaces causeed by vegetation or boulders and cobble. | 50-79% of the streambank surfaces covered by vegetation, gravel or larger material. | 25-49% of the stream- bank surfaces covered by vegetation, gravel, or larger material. 3-5 | Less then 25% of the streambank aurieces covered by vegetation, gravel, or larger material. 0-2 |
| . Streamside cover (b) | Dominant vegetation is shrub. | Dominant vegetation is of tree form. | DORINANT vegetation is grass or forbes. | Over 50% of the stream- bank has no vagetation and dominant material is soil, rock, bridge materials, culverts, or mine tailings. |
| | 9-10 | 6-8 | 3(-5) | 0-2 |
| olumn Totals | seore (D) | · | — †, | 26 33 61 |
| | | | | |

Figure 5.2.1. (Cont.).

Sites 4 and 5

| | | | ERISATION/WATER QUALS DATA SHIRT | 1 91 | 119 (reek - 1 |
|---------------------------|--|-------------------------------|---------------------------------------|---|------------------|
| RISICAL CRARACT | BRISATION | | | | |
| I PARIAD SQUE/IN | BRUTARS MAINS | | | | |
| redominant furr | ounding Lond Uses | _ | | | |
| | d/Pasturo Agricultus | ai) Booldontial | Commercial (| ladustrial Other | |
| bedeterske i | Prosion: Sono (Hederst | a) Brevy | | | |
| ocal Veterahed | mps follution: So ovide | nco Bono Potobilo | 1 sourçes (Ob-Loue | . Sources | |
| stipsted Streem | width 6 a Estimoto | | • <u>0.1</u> • , eu | - • • · · · · · · · · | |
| ligh water Mark | <u> </u> | Dea Procent: Too | Fo V_ Chons | otizadi zee 📈 🚜 🗀 | - |
| euobă Consci (Di | | Partly Sheded. | Sheded | | |
| EDIMENT/SVESTSA | 7. | | | | |
| edinent oders: | | Potroloum Chomic | e) Asserbic | Bone Other | |
| edinent Sile: (| | dorate Frefuse Fapor Fibor | Sand Railet Shol | Ila Orbae | |
| rodinent Dapasit | o: Studgo Sauduot na of stomos which are So | - | | | |
| | morganic Substrate Compos | | \ ! | Organic Substrate Compon | ent. |
| | | Percent Composition | | , | Cosposition |
| ubetrate Type | Diseaser | in Besphing Aces | Substrate Type | Characteristic | 14 Searling Aces |
| leulder leulder | 1756-au (10 (a.) | Im | Setritus | Sticks, Wood, Contac Stant Materials (CPON) | little snag |
| interes Praves Pand | 44-354-00 (2.3-10 10.) 3-64-00 (0.1-2.5 (0.) 0.06-2.00-00 (gritty) | =500 | Ruck-Red | Black, Tory Fine Greenia (FFOR) | |
| iilt iit | .00606-mm (gt.tty) | - 3 0° | Mor1 | Gree, Shall Frequents | habitat |
| | 11001-00 1-1111 | | · · · · · · · · · · · · · · · · · · · | | available |
| AFER QUALITY | | | | | |
| emperature | _ C Disselved Daygon | | _ Conductivity | Olber | |
| setrument(s) Osc | · | | | | |
| train type: 👊 | Sparter (Arceneter) | | | | |
| later Oders: (Sei | (0.1) davege Pat | releum Chemicai | Bees Other _ | | |
| lator Surface Di | in flich Shoon | Globa Piocks | (done) | متداد الدادية | |
| orbidity: Cless | : Slightly Turble | Inchid Shidne | Water Color | green w algae | |
| | | | | | |
| MEATHER COMBITION | ™ hot | | | | |
| | (. | 1 | | | |
| PROTOGRAPH MUMBE | • mussels | presen+ | | | |
| | | bottoms fairly | colid at | mucky | |
| OBIERVATIONS AND | 000 | WITTOMS TRIVING | SULLY, MOL | mound | |

å

| | | | Cate | 1×1Y | | 7/5/94 | |
|--|--|---|--|---|---|---|-----|
| abitat Parameter | | ellent | Good | | FALS | Poor | _ |
| i. *Bottom substra gvailable cover | gravel, s | hen 50% rubble, ubmerged logs, banks, or ble hebitat, 16-20 | 30-50% rubble, gravel or other stable habitae Adequate habitat. II-1 | t. or other Habitat less tha | ubble, gravel stable habitat. availability n desirable. 5-0 | Less than 10% rubble gravel or other stabl habitat. Lack of habitat is obvious. | |
| 2. Enbeddedness (b) | bouldet between | cobbie, and perticles are b and 25 t ad by fine | Gravel, cobble, and boulder particles are between 25 and 50 t sucrounded by fine sedament | boulder between suttound | cobble, and particles are 50 and 75 t ed by fine | Gravel, cobbie, and boulder particles are over 75 % surrounded by fine sediment | |
| 1. 50.15 cms (5 eff *Flow(4) at rep. flow(4) | | 15 cms (2 cfs) 15 cms (5 cfs) 10~20 | 0.03-0.05 cms (1-2 cfs 0.05-0.15 cms (2-5 cfs 11-1 |) 0.03-0.0 | | (0.01 cms (.5 cfs) (0.03 cms (1 cfs) | 5 |
| or yq.15 cma (5cf: Velocity/dapth | [>0.5 m) [c0.5 m) [>0.1 m/s shallow | .1 m/s;, deep;; slow, shallow;; fast s), deep; fast, habitats all | Only 3 of the 4 habita' categories present (missing riffles or ru- receive lower score the missing pools). | categori ns (missing | f the 4 habitates present riffles/runs lower score). | Dominated by one velocity/depth category (ustally pool). | |
| | present. | 16-20 | ,11-1 | 5 | (6-)0 | 0- | 5 |
| 4. • Channel alter | ment of point ba | t no enlarge- islands or rs, end/st elization. | Some new increase in to formation, wostly from coerce gravel; and/or some classical present. | new grav on old a pnois pe w/silt; ments or | deposition of vel, coarse send and new bers; setially filled and/or embents both banks | Heavy daposits of fir material, increased t devalopment; most poor filled wysit; and/or extensive channelizat | ion |
| 5. Bettom scouring deposition | | | 5-30% affected. Scour at constrictions and where grades steepen. Some deposition in poo | Deposits obstruct is, strictio | effected. and scour at tons, con- ms and bends. ling of poels. | More than 50t of the bottom changing nearly year long. Pools almost absent due to deposition. Only large rocks | _ |
| | | 12-15 | (A) | 1 | 4-7 | in riffle exposed. | 3 |
| (a) From Ball 198. | 2. | | | 2 | 7 | | |

Figure 5.2-1. Habitat Assessment Field Data Sheet for use with all Rapid Bioassessment Protocols.

| | HABITAT AS | SSESSMENT FIELD DATA SHEET . | cone, Big C | veek - DKS |
|---|--|--|---|---|
| fabitat Parameter | Excellent | Category | Fair | 7 5 94 |
| Pool/piffle, tun/bend ratio distance between riffles divided by stream width) | 5-7. Variety of habital. Deep riffles and pools. | 7-15. Adequate depth in pools and riffles. Bends provide habitat. | 15-25. Occassional ciffle or bend. Bottom contours provide some habitat. | >23. Essentially a straight stream. Generally all flat water or shallow riffls. Foor habitat. |
| 7. Sank stability ^(a) | Stable. He evidence of ecosion or bank failure. Side slopes generally (30%. Little potential for future problem. | Muderately stable. Infrequent, small areas of ecosion mostly healed over, Side slopes up to 40% on one bank, Slight potential in extreme floods. | Moderately unstable. Moderate frequency and size of erosional areas; side slopes up to 60% on some banks. High erosion potential during extreme high flow. | Unstable, Keny eroded areas, Side |
| | 9-10 | 6-4 | (3-)6 | 0-3 |
| s. Sank vegetative stebility | over 30% of the streambent surfaces covered by vegetation or boulders and cobble: | 50-79% of the streambenk surfaces covered by vegetation, gravel of larger material. 6-8 | 25-49% of the stream- bank surfaces covered by vegetation, gravel, or larger material. 3-5 | Less than 25% of the streembank surfaces covered by vegetation, gravel, or larger peterial. |
| 9. Streamside cover (b) | Dominant vegetation is shoub, | Cominant vegetation is of tree form. | Dominant vegetation is grass or forbes. | Over 50% of the stream- bank has no vegetation and downant material is soil, rock, bridge materials, culverts, or mine tailings. |
| | 9-10 | 6-1 | (3)5 | 0-2 |
| Column Totals | <u> 59</u> | · | <u> </u> | 22 — |
| | | | | |
| | | | | |

Figure 5.2-1. (Cont.).



Rush Creek Reference Site 1

Barr Creek County Line Road Site 2









Big Creek

Site 4 (upstream)



Site 5 (downstream)

Slumping Banks Site 5

